A paperless fetal monitoring system

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THE PROBLEM

One of the most prevalent plague in state assisted health care of third-world-countries is not the lack of resources for buying new and sophisticated medical appliances (which stands for an "acute" spending); indeed, the problem consists of attaining assets for the maintenance of that machines (the "chronic" spending).

Also, new machines and diagnostic procedures may lead to expensive archiving systems (like air-conditioned rooms for paper-film and other heat- and moisture-sensible media storage). Usually a manual, human-dependent and intrinsically precarious information storage method, like using binders, is employed. Just by putting an exam out of order, that information will be eventually lost forever, contributing to the chaos onset inside the hospital.

There are five HP 8041A fetal monitor at the Department of Obstetrics of Hospital das Clínicas. They may produce as many as 200 cardio-tocography exams a weak, all of them ready to be analyzed and filed by the staff. Up to 50 yards of imported (thus expensive) thermal paper are going to enlarge the patient records.

THE SYSTEM

A new computerized fetal monitoring system has been developed at University of São Paulo School of Medicine. It uses a very inexpensive microcomputer (like a junk-dealer refused PC AT 286-compatible with 512 kbytes RAM, monochrome VGA, and one 3.5" diskette-drive) and a 10-bit analogic to digital converter board in order to acquire the fetal heart rate and uterine pressure signals from up to four unmodified HP 8041A fetal monitors simultaneously. Signal quality and event marker (operated by the physician) data are also collected for each fetal monitor. The sampling frequency can be configured from 0.8 to 18 Hz.

Using 2 Hz as default, up to 2 hours of continuous registration can be achieved with 4 monitors running simultaneously, or 8 hours of registration with just one monitor (peri-parturition exam). The typical examination is 40 minutes long, thus requiring less than 10 kbytes of disk memory per patient. Personal patient data is included together with the signal data. A one-dollar diskette can hold 140 exams. Commercially available file compression programs can virtually put as many as 300 exams into one single 1.44 Mbytes diskette. The software consists of two independent but logically linked modules: acquisition and display-analysis. These programs are less than 64 Kbytes large each and run under native DOS. The interface is default-driven, ensuring that personnel without skills on computers (as our doctors are) can use this system.

The acquisition module is able to collect data as exposed earlier in this text, showing information regarding all fetal monitors in the computer screen. It saves each exam as a unique binary file. The display module uses this file as an input, and shows the exam in a zoomable window. Simple computation is applied to get the fetal cardiac baseline rate and other data, like the occurrence of cardiac acceleration and deceleration. In the event of willing to waste some paper, the program can print a hard copy of the output trace and findings.

The system is ready for use, but the medical staff is still awkward about using it. When the routine use of this system becomes reality, it will be expected to reach four main goals: 1) to allow just one person to examine up to four patients at once; 2) to save a lot of expensive thermal paper (and storage room); 3) to facilitate information retrieval; 4) to provide a standard way of interpreting a fetal monitor examination.